

Hedonic, neural, and autonomic responses to prolonged gentle touch

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Department of Psychology, 2018

Avhandling för avläggande av filosofie doktorsexamen i psykologi som med vederbörligt tillstånd av Samhällsvetenskapliga fakulteten vid Göteborgs Universitet kommer att offentligt försvaras fredagen den 23 mars 2018, kl. 10:00, Sal F1, Psykologiska institutionen, Haraldsgatan 1, Göteborg.

Fakultetsopponent: Professor Alberto Gallace, Department of Psychology, University of Milano-Bicocca, Italy.

The thesis is based on a summary and the following papers:

- I. **Triscoli, C.**, Olausson, H., Sailer, U., Ignell, H., Croy, I. CT-optimized skin stroking delivered by hand or robot is comparable. *Frontiers in Behavioural Neuroscience* 2013: 7(208). doi:10.3389/FNBEH.2013.00208
- II. **Triscoli, C.**, Ackerley, R., Sailer, U. Touch satiety: differential effects of stroking velocity on liking and wanting touch over repetitions. *PlosOne* 2014: 9(11), E113425. doi:10.1371/JOURNAL.PONE.0113425
- III. Sailer, U., **Triscoli, C.**, Häggblad, G., Hamilton, P., Olausson, H., Croy, I. Temporal dynamics of brain activation during 40 minutes of pleasant touch. *Neuroimage* 2016: 139, 360-367. doi:10.1016/J.NEUROIMAGE.2016.06.031
- IV. **Triscoli, C.**, Croy, I., Steudte-Schmiedgen, S., Olausson, H., Sailer, U. Heart rate variability is enhanced by long-lasting pleasant touch at CT-optimized velocity. *Biological Psychology* 2017: 128, 71–81. doi.org/10.1016/j.biopsycho.2017.07.007



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Abstract

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Physical contact among individuals, such as caressing and cuddling, is connoted by a strong emotional value, and is usually perceived as a pleasant and rewarding experience. C tactile (CT) afferents are a class of fibres that are specific channels for detecting touch at a caress-like velocity (between 1 and 10 cm/s). This velocity usually occurs during social interactions and is perceived as pleasant. Alongside rich literature about short-lasting pleasant touch, the aim of the present thesis is to increase the knowledge of the neural and physiological dynamics of pleasant touch performed for time scales longer than several minutes. In paper I, handheld and robotic brush strokes were compared in terms of pleasantness in order to validate the use of a robot for delivering the tactile stimulation in the prolonged touch paradigms used in papers II, III and IV. Moreover, the influence of a cognitive factor such as the awareness of the source of the stimulation on the evaluation of pleasant touch was investigated. Brush stroking was applied on the forearm either manually or with a robot, and the participants were either aware or unaware of the source. The results showed that robot and human touch were equally pleasant, proving the convergent validity of the two measures. This was also true regardless of the awareness of the source, meaning that, in the present context, there was no strong cognitive modulation on the perception of pleasant touch. In paper II, in a prolonged touch paradigm, the concept of “satiety for touch” and the rewarding aspects of “liking” (pleasantness) and “wanting” (willingness to be exposed again to the same stimulus) were investigated, with both velocity variation (experiment I) and one single velocity (experiment II). In experiment I, “liking” and “wanting” decreased only for the velocity optimally activating CT afferents (3 cm/s), but the stimulation was still pleasant at the end. In experiment II, “liking” and “wanting” decreased for both stroking at 3 and 30 cm/s, with a steeper decrease for 3 cm/s. These findings indicate that “satiety” occurs particularly for the CT optimal velocity; however it takes time. Paper III investigated the neural response to prolonged CT optimal touch. Forty minutes of brush stroking was performed while the participants were scanned with functional Magnetic Resonance Imaging (fMRI). Whole brain-based analyses showed decreased activation over time of primary and secondary somatosensory cortices (SI and SII), and increased activation in orbitofrontal cortex (OFC) and putamen. OFC activation was correlated with the perceived pleasantness, which decreased over time although never below the neutral point. The results demonstrate that long-lasting stroking is processed in similar areas to shorter-lasting stroking, and that the recruitment of the reward-related orbitofrontal network likely reflects updating of the rewarding value of touch. In paper IV we explored the psychological and physiological effects of either 35 minutes of brush stroking at the CT optimal velocity or vibration on stress response, reward sensitivity, current mood and interoceptive awareness. The perceived pleasantness decreased for both groups, while intensity remained stable. The increase in heart rate variability (SDNN) observed exclusively for brush stroking was related to its higher pleasantness and intensity compared to vibration. No significant changes in the other variables were found. The findings demonstrate the potential of prolonged CT-optimal touch in improving autonomic regulation. This thesis contributes to the growing field of affective touch by demonstrating that prolonged CT optimal touch is a pleasant experience processed by the reward-related neural network, which provides positive autonomic effects. As well, in the present context, pleasant touch was not affected by the source of the stimulation nor by the awareness of it. These findings may be relevant for situations of prolonged touch such as touch therapies and massages, in order to increase the well-being of the individuals.

Keywords: long-lasting touch, CT afferents, pleasantness, liking, wanting, satiety, orbitofrontal cortex, reward, heart rate variability.

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